EDITORIAL ARTICLES.

THE SURGERY OF THE BRAIN AND SPINAL CORD.

Cerebral surgery is advancing to a position well abreast with her twin sister, abdominal surgery. In a former volume of this journal[1] appeared a review of the status of operative interference with the human brain at that time, and since then, as the occasion arose, the various notable advances in this direction have been chronicled in the index of surgical progress. The subject has again[2] been discussed both from the neurological and the surgical stand point in two recent papers. Dr. SEGUIN believes that the diagnosis of a case of supposed tumor of the brain should, before an operation is attempted, be carefully worked out in not less than five lines of inquiry or secondary diagnoses. 1. The diagnosis of the tumor within the skull, and more especially, in or upon the cerebral hemispheres. 2. The diagnosis of the exact location of the tumor. 3. The diagnosis of the depth of the tumor; whether it be cortical or subcortical. 4. The diagnosis of the solitude or multiplicity of the tumor. 5. The diagnosis of its nature.

First.—The diagnosis of cerebral tumor is accurately made, as a rule, by the experienced physician from the gradual development of symptoms, such as headache, convulsions local or general, paresis and paralysis, co-extension of these symptoms, moderate anæsthesia, choked disk, hemianopsia, stupor, coma and slow pulse.

[1]Operative Attacks upon the Human Brain. By S. LLOYD, M. D., ANNALS OF SURGERY, vol. iv. No. 6 December, 1886, p. 499.

[2]Contribution to the Diagnosis and Surgical Treatment of Tumors of the Cerebrum. By R. F. WEIR, M. D., (New York,) and E. C. SEGUIN, M. D., (New York.) American Journal of the Medical Sciences, July, August, September, 1888.

An address on the Surgery of the Brain and Spinal Cord, delivered at the annual meeting of the British Medical Association. By WILLIAM MACEWEN, M. D., (Glasgow,) British Medical Journal, Aug. 11, 1888; Lancet, Aug. 11, 1888; Medical News, Aug. 18, 1888.

Second.—The diagnosis of the topographical location of the tumor is arrived at through the application of the principles of cerebral localization. 1. Lesions of certain parts of the cerebrum produce no directly localizing symptoms, the patient exhibiting only general symptoms of cerebral disease. In this category fall (*a*) the frontal lobes strictly speaking, except the caudal extremities of its external gyri, more especially the second and third; (*b*) the apex and base of the temporal lobes on both sides, and the whole of the lobe on the right side; (*c*) the external and basal aspect of the occipital lobes; (*d*) parts of the parietal lobes; and (*e*) the central ganglia. The fasciculi of medullary substance connecting these parts with the base of the brain and with other parts of the cerebrum (commissural fibres) are included as inexcitable parts.

2. There remain two irregular divisions of the cerebrum, lesions of wkich give rise to special, definite, localizing symptoms: I. The excitable or motor zone, cortex and attached fasciculi; II. The known sensory zones with fasciculi.

1. *Tumors of the motor zone.*—(*a*) Tumors of the caudal extremities of the third frontal gyrus (on the left side in dextrous persons) produces at first slowness of speech and paroxysmal motor aphasia. Their extension toward the rest of the motor zone causes paresis and convulsive movements of the tongue, face and upper extremity on the opposite side. Later still these symptoms, motor aphasia, spasmodic movements, and paralysis of the tongue, face and upper extremity, become more frequent and finally permanent; with occasional spasms.

(*b*) Tumors of the basal ends of the pre- and post-central gyri cause at first convulsive movements, or paresis, or both, of the opposite half of the tongue; later, paroxysmal motor aphasia, spasm and paresis of the face and upper extremity; last, complete paralysis of one half of the tongue, of the face and upper extremity, and permanent aphasia, with occasional convulsions (Jacksonian movements.)

(*c*) Tumors of the caudal extremity of the second frontal gyrus, where it becomes confluent with the lower third of the pre-central gyrus, produce at first paresis with convulsive movements (or *vice*

versa) of the facial muscles of the opposite side; later, the same symptoms with the addition of more or less motor aphasia, paresis of one half of the tongue, paresis and spasm of the upper limb, more especially the fingers; lastly permanent paralysis of the face, half of the tongue and hand, permanent aphasia and occasional spasms.

(*d*) Tumors starting in the lower middle third of the pre-central gyrus first become apparent by spasm and paresis of the opposite thumb and finger, and occasionally the whole hand and forearm. After further growth, the irritative and destructive symptoms appear in the face and tongue and more or less marked aphasia occurs, the paresis of the hand and forearm becoming complete paralysis. A peculiarity of this centre, not as yet proven to exist in lesion of the other centres of the motor zone, is pronounced subjective numbness and slight though usually demonstrable tactile anæsthesia.

(*e*) Tumors of the upper middle third of the pre-central gyrus—and perhaps of the post-central also—cause early symptoms in the muscular apparatus of the upper arm and shoulder. Later the spasm and paresis extend to other parts, according as the growth extends ventrad or dorsad. In the former case, the forearm and hand, the face, and half of the tongue show symptoms, and lastly, aphasia may occur, though rarely complete. If the tumor grows dorsad towards the longitudinal fissure, spasm and paresis, later paralyses show themselves successively in the thigh, leg and foot.

(*f*) Tumors of the upper third or top of the pre- and post-central gyri and of the paracentral lobule at first cause symptoms, convulsive and paretic in the thigh, leg or foot. There is every reason to believe that in man the special subcentre for the hip and thigh is the cortex of the central gyri where they bend over to form the paracentral lobule, while the lobule itself innervates the legs and toes. Later, by extension of the morbid growth, there are symptoms in the arm and hand, rarely in the face, probably never aphasia—except in the rare cases where a peculiar vitality of the patient permits the growth of a colossal tumor. Or there may be invasion of the crural centre of the opposite hemisphere, producing paralysis with spasm or without spasm of both legs—pseudo-paraplegia.

2. *Tumors of the sensory zone.* — Lesions of those areas of the sensory zone whose functions are best known to us, viz., the centres for half vision and for audited speech manifest their presence almost exclusively by the so-called destruction symptoms. Irritation symptoms probably occur but we have little knowledge of them.

(*a*) A patient presenting, besides the general symptoms of an intracranial growth, such a specific symptom as verbal deafness, without marked hemiplegia, hemispasm or hemianæsthesia, probably has a tumor involving the left superior or dorsal temporal gyrus or its subjacent white fasciculus. The symptoms produced by extension of this growth would be mostly sensory, such as paræsthesia, loss of muscular sense, and later, anæsthesia of parts on the opposite side of the body.

(*b*) A patient who has headache, vomiting, choked disk, dulness tending to stupor, increasing hemianæsthesia with lateral hemianopsia —dark half-fields on the same side as anæsthesia—without hemispasm or hemiplegia, quite certainly has a tumor in the white substance of the occipital lobe.

(*c*) If with the above named general symptoms of cerebral tumor, we find lateral hemianopsia alone as a localizing symptom—*i. e.*, without hemispasm, hemiplegia and hemianæsthesia—there is almost certainly a tumor on the inner or mesial aspect of the occipital lobe, opposite to the dark half-fields, compressing and destroying the cuneus. The symptoms to be expected from the extension of such a tumor are, from its growth upward, weakness and even paralysis of the lower extremity of the same side as the dark half-fields; and from its downward growth symptoms of injury to the cerebellum and optic lobes.

Third.—The diagnosis of the depth of the tumor—whether it be cortical or sub-cortical—is much more doubtful. The only symptoms which are sufficiently special to be of advantage are (*a*) the nature and location of the signal symptom, the presence and order of appearance of spasm or paresis; (*b*) presence or absence of headache; (*c*) changes in local cranial temperatures. But a careful consideration of these points leaves us in such uncertainty that we are obliged to conclude that at the present time it is impossible clinically to distinguish a cortical from a subcortical tumor.

Fourth.—The diagnosis of the solitude of the tumor is less uncertain, although it must necessarily remain doubtful. (*a*) When the symptoms of cerebral tumor occur in an individual who already bears a tumor or presents signs of tuberculosis, the probability that the cerebral secondary deposit is multiple will be very great, and for this and other considerations an operation will be unadvisable. (*b*) When symptoms indicating lesions of different cerebral centres or systems are present, and especially when symptoms of basal disease are combined with those characteristic of tumor of the motor or sensory zones, the probability of double or multiple lesion will be so great as to amount almost to a certainty.

Fifth.—The diagnosis of the nature of the tumor is all important as a negative element in some cases in deciding for or against an operation. (*a*) It would be undesirable to interfere in a case of brain tumor complicating tuberculosis of the lungs or other organs or general tuberculosis, on account of the probability that the cerebral growth is tubercular. (*b*) The coexistence of a recognizable cancerous growth of other parts or of a cancerous diathesis would contraindicate operation because of the probability of multiple cerebral growths and the fact that other organs are affected with incurable disease. (*c*) In cases where the clinical indications point to the existence of a gumma or gummata, in spite of the contrary opinion of v. Bergmann, operation is thought desirable in well selected cases after a thorough medicinal treatment bas been carried out.

The diagnosis of all other forms of intracranial growths is most obscure, and we can only be guided by statistical results as to the absolute and relative frequency of the varieties ot tumors, and it should be borne in mind that the deductive application of such data to a case in hand is extremely uncertain—almost mere guess work.

It may be concluded from the foregoing discussion that "*the surgeon must be content to have the physician furnish him with a reasonably exact diagnosis of the location of the tumor and with a probability diagnosis of its solitude.*" Except in cases of secondary new formation—in which an operation is almost positively contra indicated—and in cases of cerebral gummata, the diagnosis of the nature of the tumor and of its encapsulation or infiltration should be withheld.

Seguin and Weir's case of subcortical sarcoma lying below the edge of the second frontal and the anterior edge of the precentral gyri.—A German man, æt. 39, had suffered for two years from epileptiform seizures, and for several years previously from occasional spasmodic twitchings. Observation of the patient for a couple of months, with varying medicinal treatment, showed a continuation of the seizures, paralysis of the right lower facial muscles, paresis of right arm, leg apparently normal, constant drooling from the right side of the mouth; slight aphasic and agraphic faults; slight tactile anæsthesia on the pulps of the left fingers, more marked on the thumb and index; muscular sense preserved. No symptoms in optic apparatus. The greatest tenderness to percussion, coinciding with the seat of greatest pain, was in a spot just in front of the auriculo-bregmatic line, and from 8 to 10 cm. above the external auditory meatus. This right-sided Jacksonian epilepsy with facio-brachial paresis, pointed to a tumor, probably sarcomatous and subcortical of the left motor zone in the facial centre. Under ether anæsthesia, the point of operation having been located by Dr. SEGUIN, Dr. WEIR raised a scalp flap, and with the trephine and gouge removed a portion of the skull, three by two inches. The membranes being opened, the brain was observed to bulge decidedly into the opening, although nothing abnormal was seen on the exposed surface. After some unsuccessful exploration with the finger, firm pressure posteriorly encountered a deep resistance of a hard mass of the size and shape of the end of the forefinger underneath the previously suspected convolution. It was readily enucleated, although not encapsulated, with the aid of a blunted Volkmann's spoon. A separate piece, the size of a pea, was then recognized and removed. The toilet of the wound was then made, drainage supplied, the dura sutured, the disks of bone and a number of the fragments removed with the rongeur, reimplanted and the wound closed. The patient progressed to a good recovery, being allowed to go home after a month, in good general condition and unquestionably better as regards paresis of face and hand, but still with occasional twitchings, some headache and slight paresis of right lips and cheeks.

OPERATIVE PROCEDURES.—The following points are particularly noted by Dr. WEIR: The operation should be attended with the strictest antiseptic precautions throughout. A curved flap both of the scalp and dura mater is of advantage in securing protection to the brain after the completion of the operation. Hæmorrhage from the large scalp-incision involved may be controlled to a considerable extent by encircling the head tightly on a line with the occipital protu-

berance with a rubber band. The careful outlining of the region to be explored upon the shaven scalp is of no avail after the flap has been lifted away, and it is therefore of some importance to indicate the site of the trephine center upon the bone itself.

The cranial opening should be a large one both for the removal of a large growth and for exploratory purposes. Horsley applies a two-inch trephine in two places; Weir uses a one-inch trephine. The intervening ledge of bone can be quickly cut away by a muscular surgeon with Luer's or Robert's rongeur forceps. A dental or electrical bone-cutter permits more rapid work. The dura mater should also be freely opened, the accuracy of diagnosis thus obtained more than compensating for the supposed additional risk. The exploring needle is of little value, and it has been known to cause fatal hæmorrhage. After exposure of the brain, if by its surface markedly bulging, which is always abnormal, or if by its loss of pulsation or by a marked change in color, it does not indicate the presence of a tumor, solid or fluid, then the surgeon should, by gentle but firm pressure, palpate the bared convolutions, and he can even insinuate the pulp of his finger under the bony edge of the opening to a short distance with safety.

Important vessels, such as the longitudinal or lateral sinuses, after the removal of the superjacent skull, can be lifted from their places and drawn aside without risk by pulling upon the dural flap. The attached base of the flap, when near a sinus, should be toward the vessel.

A bony closure of the cranial opening is most satisfactorily obtained by carefully preserving the trephine buttons in cloths wet with a 1·60 carbolic solution, and kept warm during the operation by immersing the vessel containing them in warm water. They can then be replaced after the operation, any gap being filled by the other fragments, chopped up.

Hæmorrhage from the bone may be controlled by pressure, plugging, or better still, by crushing the edges of the opening by blunt forceps. Bleeding from the dural vessels may be checked by catching them up with a tenaculum and applying a ligature. Vessels of the pia mater are easily torn, and bleeding from them is best checked by securing them with a tenaculum and applying a ligature with equal traction of its ends. Any vessel of size in the brain substance itself or in the depths of the convolutions should be seized and secured, with clamps if ligature is impracticable.

When the tumor is not strictly superficial, it can, after being recognized by palpation, be reached by an incision or by gently tearing

through the cerebral tissue with the end of the finger or a director The handle of a spoon will then very satisfactorily aid in its extraction, and a carefully blunted Volkmann's spoon is of advantage.

All hæmorrhage having been checked, a small perforated rubber drainage tube should be inserted, to be removed, especially in a favorably progressing case, as late as the end of the second or third day. The dural flap is then stitched in place with fine catgut sutures, the flap having been cut from one-eighth to one-fourth of an inch within the edge of the bone to leave space for the application of the sutures. The bone fragments now being replaced with a few strands of horsehair or catgut placed among them to emerge with the drainage tube, the scalp flap is returned and sutured, all bleeding points having been secured. Over all a sublimate dressing should be applied, with iodoform dusted over the layer resting upon the wound. Finally, it is better to keep the head somewhat elevated for a few hours after the operation.

The address of Dr. MACEWEN deals exclusively with his own extensive experience in brain surgery, and treats the subject rather clinically than diagnostically. (1) The results of antiseptic surgery having shown that inflammation, arising from exposure of and operations upon the cerebrum, could be obviated under aseptic conditions; and (2) the physiological researches which made it possible to localize by idiopathic symptoms lesions of the encephalon, having rendered possible the diagnosis of the location of certain cerebral lesions, as early as 1876 Dr. Macewen advocated operative relief in such cases.

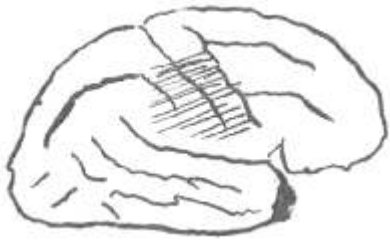
"1. *Case in which the Symptoms of Local Cerebral Disease led to the Diagnosis of a Lesion in Broca's Lobe.*—The following case was seen in July, 1876. The patient's forehead bore a cicatrix marking the site of an injury under which the skull was bare. Had his cicatrix been taken as a guide to the localization of the abscess and an operation performed there, no abscess would have been found. But other phenomena were exhibited which enabled its seat to be definitely recognized. A convulsion commenced on the right side, and gradually involved the whole body, accompanied by loss of consciousness. On its cessation, absolute hemiplegia of the right side was present, and remained for two hours, during which patient was aphasic. Both these phenomena became much less marked at the end of this period. From these symptoms the abscess was diagnosed to be situated in the

immediate vicinity of Broca's lobe. It was evident that the whole of the base of the left third frontal was not involved in a destructive lesion, otherwise the aphasia would have persisted for a much longer period. and it was probable that Broca's area had become involved in the inflammatory zone surrounding the abscess. Trusting to these localizing symptoms, it was proposed to open the abscess aseptically

by exposing Broca's lobe. Unfortunately, the result of a consultation was decidedly to negative this proposal. The parents then refused consent, notwithstanding the assumption by Dr. Macewen of the sole responsibility of advising and performing the operation. Thirty-six hours afterwards the convulsions returned and persisted until a fatal issue ensued. After death the friends acquiesced in a proposal to have the operation performed just as it should have been, had permission to do so been granted during life. The skull was trephined, the brain exposed, and an instrument was introduced through the third frontal convolution for half an inch, when pus flowed through the incision proving the accuracy of the diagnosis, and giving poignancy to the regret that the operation had not been permitted during life. The abscess, about the size of a pigeon's egg, was situated in the white substance of the second and third frontal convolutions.

"2. *Case in which Motor Phenomena were the sole Guides to the Diagnosis of an Intracranial Subdural Effusion of Blood.*—In 1879 a boy had, consecutive to a fall six days previously, a series of convulsions, the twitchings beginning in the left side of the face, gradually involving the left arm and subsequently the left leg, during which consciousness was preserved. Paresis of these parts remained, though sensation was unimpaired. On the following day, there was a renewal of the convulsions, the parts being affected in the same general order, but the convulsions persisted and finally became general, with loss of consciousness. These motor phenomena indicated a lesion on the

right side of the brain, pronounced at the middle and lower portion of the ascending convolutions, as the face and arm centres were the first to show evidence of stimulation. The lesion was evidently of an irritative nature such as might be occasioned by severe cerebral contusion, and presented a sufficiently clear guide to the localization of the lesion in the lower part of the fissure of Rolando. It was therefore resolved



to expose that portion of the brain. As a preliminary the head was shaven, when a scarcely perceptible irregularity was detected in the cranial vault near the coronal suture. When the skull was exposed, a fissure was discovered running across the coronal suture. Trephining was performed at a point slightly behind the auriculo-bregmatic line, and midway between the external auditory meatus and the vertex. This point happened to correspond to the posterior extremity of the fissured fracture. There was no blood between the dura mater and the skull, but the dura had a very dark color. This membrane was opened and gave vent to two ounces of fluid and coagulated blood contained in the subdural cavity. The operation was conducted aseptically, and the patient made an uninterrupted typical, afebrile recovery. There was no recurrence of the fits, the paralysis of the left arm soon disappeared, and he is living now, and in perfect health.

"3. *Case of Tumor of Dura Mater in which the symptoms exhibited pointed to lesion in frontal lobe.*—In 1879, an idiopathic case came under observation, in which the totality of the symptoms indicated a lesion in the left frontal lobe of the brain. It occurred in a patient the subject of a small tumor above the left eyeball in the orbital cavity. A tumor had previously been removed from that position, and had now recurred. Other symptoms had however meanwhile presented themselves. The left pupil was in a state of stabile myosis there was obscuration of the intelligence, slowness of comprehension, want of mental

vigor and pain in the head. These pointed to the probability of a lesion in the left frontal lobe, but were not sufficient to permit a diagnosis to be made. The patient was therefore placed under the observation of an educated skilled nurse. Some weeks later, a series of convulsions occurred, the initial stages of which were carefully recorded by the nurse, without which the key to the brain lesion as indicated by the convulsion would have been lost, as when seen by Dr. Macewen they had become general, and threatened speedy dissolution. The convulsions were at the onset, strictly confined to the right side, commencing in the face and arm, and confined to these two parts during the initial attacks, the leg on the same side was effected during the third seizure, and ultimately the convulsions became general, with complete loss of consciousness. These phenomena were construed as indicating extension of the irritation to the lower and middle portions of the

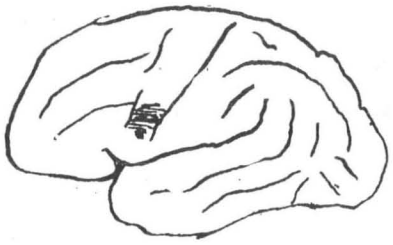
ascending convolutions, and when this was considered along with the former evidence, it was concluded that an irritative lesion existed in the left frontal lobe. On these grounds it was resolved to trephine midway between the centre of the ascending convolutions and the anterior aspect of the cranium. At this point a minute nodule the size of a barley grain was detached, on the outside of the skull. A large trephine was applied, a disc of bone removed and a tumor of the dura mater, which was exercising pressure on the brain was exposed. It was half an inch in thickness at this point, gradually becoming much thinner and spreading all over the anterior two-thirds of the frontal lobe. The tumor was after a prolonged operation carefully dissected out along with the brain membranes, where they were involved in the neoplasm. The patient rapidly recovered, was restored to perfect health and subsequently was able to gain her own livelihood. She lived for eight years afterward, ultimately becoming affected with chronic Bright's

disease from which she died. The skull and brain were examined, and there was no trace of further tumor growths. This case was published in 1879."

The author then adds three cases operated upon in 1883, (5) an intracranial effusion of blood, (6) a syphilitic tumor in the paracentral lobule and (7) an extravasation of blood into the substance of an ascending convolution, all of which were diagnosed by motor symptoms alone and all of which were relieved by operation. He also in 1881, localized (4) an abscess in the temporo-sphenoidal lobe, which he opened much to the relief of the patient, who, however, died from exhaustion soon after. All of these operations were done before 1883, which is an important point in considering priority of operation.

In support of his belief that in many cases the localization of brain lesions is easy Dr. Macewen adduces several cases, which we quote in full.

"8. *Epilepsy (Jacksonian) induced by Focal Facio-Lingual Lesion, Cured after Removal of Cyst from Brain.*—A man, æt. 22, suffered



epileptiform convulsions, each lasting from two to three minutes, and as they occurred on an average every five minutes, he consequently had over one hundred in twenty-four hours. The convulsions were limited to the tongue, the right facial muscles, and the platysma on the same side. When they subsided, the parts remained paralyzed. Consciousness was retained throughout. Eight years previously, he received an injury to the head, after which his right arm became weak, the weakness persisting though he was quite able to work. It was clear

that an irritating focal lesion existed, confined to the base of the ascending convolutions, causing a Jacksonian epilepsy. The only question was, whether the base of the ascending parietal was involved as well as that of the ascending frontal. The contraction of the platysma on the opposite side is asserted to be induced by stimulation of the base of the ascending parietal. Dr. Whitelocke suggested, however, that the platysma is often supplied by a branch of the facial, so that a single lesion in the base of the ascending frontal would be sufficient to account for the whole phenomena. The operation was at once undertaken, when in the lower part of the ascending frontal, a cyst about the size of a filbert was found situated partly in the cortical and partly in the white substance of the brain, and was surrounded by a narrow zone of encephalitis. In manipulating the medullary substance, in process of removal of the cyst, the patient, while under chloroform, had a convulsion, confined to the same group of muscles as were affected in his fits prior to the operation. The convulsion ceased with the removal of the cyst, and he has never since had another. The wound healed firmly under one dressing, the paralysis of the facial muscles soon disappeared, and he has since been constantly at work. The power of the right arm has also been increased. Possibly the cyst might have caused indirectly slight pressure on, or setting up an inhibitory action of the middle portion of the ascending frontal."

This care affords important evidence of the position occupied by the facio-lingual centre in man, and on the whole corroborates that assigned to it by experiments on the lower animals. It was also interesting to note, when the part in the brain was exposed and irritated that it gave rise to the same kind of convulsion.

9. "*Protospasm of the hallux preceded by sensory impressions and followed by paralysis.*—In another instance, a very definite protospasm accompanied by a sensory impression gave the key to the localization. It occurred in a girl, æt. 7, the subject of frequently recurring attacks of severe epileptiform seizures, followed by paralysis of the affected parts. At the onset of these attacks, patient first experienced in the great toe of the right foot a painful sensation of such severity as to cause her to scream out. Shortly after that, the toe was firmly extended in tonic spasm which lasted about five minutes. Sometimes this ended the attack. More frequently, it was followed by clonic contractions of the muscles of the right foot, leg and thigh, where the convulsions often terminated.

"Occasionally they extended to the muscles of the trunk, then to those of the right side of the face and right arm, the contractions ceasing in the order of accession. Rarely did they involve the opposite side, and when they did, patient lost consciousness. Though there was motor paralysis in the affected parts, the cutaneous sensibility remained unimpaired.

"From the great number of fits which patient had, following each other in rapid succession, occurring in parts affected with paresis the result of former attacks, while the cutaneous sensibility remained unimpaired, and from the limited area affected, it was concluded that the lesion was cortical. The sensory impression in the hallux followed by tonic and then clonic contraction of the same part, extending to the lower limb, pointed to the upper region of the ascending convolutions as the area of irritation. From the general condition of the patient

and family history, the lesion was probably tubercular, and if so might be multiple. During operation the upper portion of the descending convolutions was exposed, and with the exception of a few tubercular nodules the size of barley grains adhering to the vessels over the upper part of the ascending frontal, there was nothing visible on the surface. On careful palpation of the ascending convolutions, there was found in the upper part of the ascending parietal, a circumscribed nodule buried in the brain substance, which on exposure by cutting through the grey matter was seen to be a tubercular tumor about the size of a hazel nut which was easily shelled out. As an immediate result, there was prolonged trepidation of an erratic kind, affecting the muscles of the right side of the body, but especially those of the arm and leg. These were continuons for fully a week, thereafter gradually subsiding. There have been no fits for over a year, and the girl is now in excellent health.

"The marked sensory impressions which this lesion produced, support Dr. Gowers' opinion that the parts in the so-called motor area subserve a sensory as well as a motor function. The localization of the movements of the hallux in the upper part of the ascending frontal has not been borne out by this case, (unless the minute barley grain tubercular nodules attached to the vessels in the pia mater could account for the stimulation), the tumor being found in the upper part of the ascending parietal, but the whole lesion could be included in the ring which Beevor and Horsley place on the upper portion of the ascending convolutions.

10. "*Brachicorural monoplegia; cyst removed from upper part of ascending convolution.*—In another, occurring in a boy, æt. 3, a brachiocrural monoplegia with late rigidity was present, the result of a traumatism received eight months previously. In it a large thick

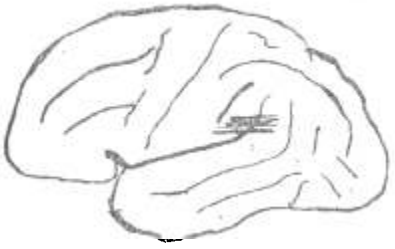
walled, sub-dural cyst, containing clear fluid was found pressing upon the motor convolutions, and a spiculum of bone detached from the inner table of the skull was seen to have penetrated the brain. These were removed, and the bone was replaced in normal position. The patient made an uninterrupted recovery. The paralysis with the contraction of the muscles passed off to a great extent. He could neither walk nor stand before the operation. Now he can run about and use his hand well, though there is still a paresis in both."

With these data from the experience of Macewen as well as from cases reported by Godlee, Horsley and many others, it is clear that the motor and sensory phenomena form reliable guides to localization of lesions in the central convolutions,

The following case is an illustration of the fact that the diagnosis of cerebral lesions in non-motor regions may also be made from sen-

sory phenomena. It also shows the difficulty of finding the exact clue to the lesion, and how easily it may be overlooked.

"11. *Psychical blindness the guide to a hidden lesion in angular gyrus. Interesting medico-legal aspects. Recovery.* A



man who had received an injury a year previously, suffered from deep melancholy, strong homicidal impulses relieved by paroxysms of pain in the head of indefinite seat. Though the pain was excruciating, he welcomed it ,as it temporarily dispelled the almost irresistible desire to kill his wife, children or other people. Prior to receiving this injury, he was perfectly free from impulses of this kind, and had a happy life with his family. Behind the angular process of the frontal there was a slight osseous depression which could not account for his symptoms. There were no motor phenomena, but on *minute* inquiry it was discovered that immediately after the accident, and for about two weeks subsequently, he suffered from psychical blindness. Physically he could see, but what he saw conveyed no impressions to his mind. An object presented itself before him which he could not make out, but when this object emitted sounds of the human voice, he at once recognized it as a man who was one of his fellow-workers. By eye sight he could not tell how many fingers he held up when he placed his own hand before his face, though by exercise of his volition in the act and by his own sensations he was cognizant of the number. He had been in the habit of reading the New Testament, and when he had so far recovered from his injury, he wished to resume his reading. He knew where the book lay near his bed and could put his hand on it in the dark. One day he stretched out his hand, took the book, recognizing it by its smooth leather covers and the deeply indented letters on its

back ; he opened it, saw what he considered must be the letters, and the blocking of them into divisions for the words, but they were unknown symbols, they conveyed no impression of their meaning, the memory of their signs was gone, it was a sealed book to him.

"These phenomena, however, gave the key to the hidden lesion in his brain. On operation the angular gyrus was exposed and, it was found that a portion of the internal table of the skull had been detached from the outer, and had exercised pressure on the posterior portion of the supramarginal convolution, while a corner of it had penetrated and lay imbedded in the anterior portion of the angular gyrus. The bone was removed from the brain and reimplanted in proper position, after which he became greatly relieved in his mental state, though still excitable. He has made no further allusion to his homicidal tendencies, which previously were obtrusive, and is now at work.

"Such cases of complete mind blindness are rare, and the definite localization in this case will assist in indicating in man what the anterior portion of the angular gyrus and posterior portion of the supramarginal convolution subserve. Other instances have been related, one where a combination of symptoms pointed to a lesion in the frontal lobe, and acting upon which a tumor was found pressing upon that area of the brain, from which it was successfully removed ; in the other a lesion was definitely recognized from the localizing symptoms as seated in the immediate vicinity of Broca's lobe. But even in such areas as the temporo-sphenoidal lobe, where destructive lesions may exist without localizing symptoms, one may occasionally by a process of exclusion definitely localize the lesion as seated in that part.

"12. *Lesion definitely localized as existing in temporo-sphenoidal lobe.*—A patient exhibiting symptoms of cerebral abscess, had on the left side ptosis, stabile mydriasis, paresis of all the ocular muscles, with the exception of the external rectus, without external squint. On the right side paralysis of the facial muscles, retaining power of emotional expression to a slight degree, and power to close the right eyelid by an effort of will, though it remained partially opened during sleep. He had also paresis of the right arm, which, during the few hours he was under observation before operation, had amounted to distinct paralysis. The leg remained normal There was no diminution of cutaneous sensibility. From these symptoms it was concluded that a single lesion must be large which could affect at once the third nerve in its course and the lower half of the ascending convolutions. Second, it was clear that it was not a destructive lesion of large size in the motor area, or the crural centre would probably have been in-

volved, thus causing absolute hemiplegia. The same observation applies with even greater force to the crus cerebri, which must be excluded, as the effects of pressure would probably have led to more extensive involvement, and had the pressure even indirectly affected this part, it would have implicated the motor strands in the reverse order, the leg first, the face last. The tentorium cerebelli would prevent pressure downward on the pons. Third, the internal capsule could not be the seat of a large lesion, or if so, hemiplegia, with destruction of 'Charcot's crossway', would have resulted. Fourth, though the whole trunk of the third nerve was involved, paresis was alone produced, probably resulting from a degree of pressure. Fifth, the lesion was gradually implicating the motor area from below upward, and was probably occasioned by pressure and its consequences. The only place where a lesion could be situated, which could produce all these phenomena, just to that precise degree, was the temporo-sphenoidal lobe.

"It was cut down upon, and in the medullary substance of the tem poro-sphenoidal lobe an abscess containing three ounces of pus was found, which was evacuated, when the whole of the symptoms vanished. Three weeks afterwards the wound was looked at for the first time and found healed."

Noting the fact that the removal of large pieces of the motor area produces permanent hemiplegia of the innervated side, Dr. MACEWEN recommends caution and the exercise of judgment in operating upon the brain. He also calls attention to the anchoring of the brain to the membranes, and of the membranes to the skull, apt to be caused by plastic effusion and cicatricial formation. The free play of the brain

within its water bed is thus impeded, and every movement causes a pulling at this point with consequent vertigo, and subsequent fits and still later encephalitis. He observes that the formation of false hernia cerebri after operations on brains in a *physiological* state is always due to decomposition and that it can be avoided in that case by aseptic measures, but the consistence of false hernia cerebri is identical with red softening of the brain, occurring in idiopathic affections in which there had been no operation, and that consequently in operations in these cases the hernia would not be obviated by asepsis.

Since 1873 Macewen has practised reimplantation of the removed fragments of the skull, asepticized and divided into minute fragments. He notes also that when the skull is intact and the ventricles distended with fluid, such as may arise in consequence of tumor in the cerebellum, the percussion note elicited will afford indications of the utmost value in early life in the diagnosis of these tumors.

The work of Macewen in this line may be summarized as follows: "Of twenty-one cerebral cases (exclusive of fractures of the skull or other immediate effects of injury) in which operations have been performed by Macewen, there have been three deaths and eighteen recoveries. Of those who died all were *in extremis* when operated on. Two were for abscess of the brain, in one of which pus had already burst into the lateral ventricles; in the other suppurative thrombosis of the lateral sinus had led to pyemia and septic pneumonia. The third was one in which besides a large subdural cyst over the one hemisphere, there was extensive softening at the seat of cerebral contusions on the opposite hemisphere, accompanied by œdema of the brain. Of the eighteen who recovered sixteen are still living, in good health, many of them regularly at work; two died, one eight years after, from chronic Bright's disease, the other 47 days after, from acute tubercular enteritis."

OPERATIONS FOR THE RELIEF OF PARAPLEGIA FROM PRESSURE UPON THE SPINAL CORD.—Certain sensory and motor phenomena due to lesions within the spinal canal have been found amenable to operation, and the spinal membranes and the cord itself can be exposed, and neoplasms and encroachments upon the lumen of the canal may be re-

moved therefrom without unduly hazarding life, as is shown by the following cases of Macewen:

"*Case of paraplegia with incontinence of urine and fæces due to connective tissue tumor at seat of angular curvature of spine; completely cured by removal of tumor and laminæ of vertebræ.*—In 1882, a boy, aged nine years, came under observation, suffering from complete sensory and motor paraplegia with incontinence of urine and fæces, which had existed for two years previously, but was absolute during the last eighteen months. For three years he had had angular curvature of the spine, most marked between the fifth and seventh dorsal vertebræ, for which he had been treated by extension and plaster jackets. The curvature had now become fixed by anchylosis of the bodies of the vertebræ. Treatment by extension and plaster jackets proved futile. The limbs were livid and cold, affected with marked spastic rigidity and with wasting of the muscles. The symptoms exhibited pointed to irritation of and pressure on the spinal cord, about the level of the sixth dorsal vertebra. Either of two conditions could have produced the pressure symptoms; the existence of a connective tissue tumor, as Charcot points out, occurs in such cases inside of the canal; or by direct encroachment on the canal by displacement of the bodies of the vertebræ. In the former case, the tumor could be removed on exposing the theca, by elevating the laminæ of the affected vertebræ: in the latter, the same procedure would permit the cord to expand backward, thus receding from the point of pressure. The paralysis having existed slightly for two years, and markedly for eighteen months, and showing no signs of amelioration under ordinary treatment, this operation was deemed expedient. On May 9th, 1883, the laminæ of the fifth, sixth and seventh dorsal vertebræ were removed. There was no pulsation in the portion of the cord exposed. Between the theca and the bone there was found a fibrous neoplasm of an eighth of an inch in thickness, which was firmly attached to the theca and covered about two-thirds of its circumference. This was carefully dissected off. The cord was then able to expand backward, and its pulsations, which up to this period were absent, began to show themselves, especially opposite the fifth dorsal. Twenty-four hours after removal of the pressure, the limbs had lost their livid color, were distinctly warmer, the spastic rigidity had greatly lessened, the sense of tickling the soles had returned, and that of touch had improved. The first return of movement was observed eight days after. Soon he had perfect control over his shincters. Six months subsequently, he was able to go about with-

out support. Five years afterward, he walked three miles to pay me a visit. He attends school regularly, joins in all the games, including foot-ball, and he says he feels quite strong.

"*A second but more aggravated case.*—In 1884, another case was seen of a somewhat similar kind, though much more aggravated, the symptoms being so far advanced as to indicate organic changes in the cord itself, which rendered operation almost hopeless. It was only on the urgent and touching appeal of the girl herself that the operation was undertaken. A dense connective tissue tumor existed between the bone and the theca, which was so firmly adherent to both that in some places the theca was elevated along with the neoplasm. The portion of the cord thus exposed was shrunken to about half its normal dimensions, and lay like an inanimate rod. After elevation of a sufficient number of laminæ to expose a portion of the cord which pulsated, the pulsations were communicated to this rod, pushing it from above downward, but there were no distensile pulsations in the rod-like parts of the cord. From the whole appearance presented at the operation it was considered that there was no hope for her recovering from her paralytic state. However, ten hours after the operation, the limbs had lost their lividity, felt warmer to the touch, and patient said she experienced "a sensation as if she were dreaming that her legs were on, and hot water was running through them." From the fourth day after the relief of pressure, she had continence of urine and fæces; for which alone she declared she would willingly have undergone the operation. Sensation quickly returned to the limbs, motion very slowly. Six months after, she could move her limbs freely. Eight months subsequent to the operation, she walked a quarter of a mile, stated she could perform many light duties in the house, besides attending to herself. She has since been very well and able to enjoy life.

"A third case was also successful, but two others have not been so: one succumbed a week after the operation, the other some months later to an attack of general tuberculosis. In both of these the temperature was high prior to the operation, and was subject to exacerbations, indicating an activity in the tubercular disease at some part distant from the anchylosed angular curvature. Since this experience no case has been deemed fit for operation in which the temperature did not run an even, regular and continuous afebrile course.

"*Abscess in the posterior mediastinum evacuated successfully.*—In connection with these cases, an abscess in the posterior mediastinum, which was exercising pressure on the heart and bronchi, and threatened life was evacuated with complete success.

"*Compression of the cord from traumatism.*—Another class of cases is that of localized compression of the cord arising from traumatism. Traumatic lesions are as a rule so gross and the destruction so complete, that in such, operative treatment can be of little service. Still, there are cases in which traumatism has produced localized pressure primary or secondary which can be relieved.

"*Paraplegia from traumatism cured by elevating connective tissue tumor and depressed arch of twelfth dorsal.*—From a coal pit accident, a man twenty-two years of age received a severe injury to the spine, at the level of the lower dorsal vertebræ, which caused absolute motor paralysis with incontinence. There was marked hyperæsthesia of the affected parts, which increased in severity during the first three weeks, so that he could not bear to have the floor shaken or his limbs touched. Between the third and fifth week a rapid change took place. At the termination of that period, the muscles of the lower limbs would not respond to electricity, they had become so shrunken and wasted that the contour of the bones stood prominently out and notwithstanding massage of the limbs since the cessation of the pain, the flexor muscles had markedly contracted causing drooping of the feet and toes, and fixation of the joints. Later, the skin over the bony prominences became red, pressure points and bed sores formed irrespective of the most scrupulous attention, the urine became ammoniacal and his temperature ran up. It was evident that a fatal issue was imminent, unless an attempt to relieve the pressure on the spine was at once made. In February, 1885, this was done. The lower dorsal and first lumbar were exposed. The arch of the twelfth dorsal was fractured and slightly depressed, and between it and the theca there existed a connective tissue tumor, measuring nearly quarter a of an inch in antero-posterior diameter, and extending from the eleventh dorsal to the second lumbar vertebra. Both above and below the twelfth dorsal, the tumor gradually shaded off to about one-half of its thickness at that point. It was confined to the posterior aspects of the canal. This tumor was carefully dissected from the theca. The same night there was a distinct improvement in the warmth of the lower limbs. He began to move his toes on the third day. A month afterward the contractures of the tendons about the ankle and feet were extensively tenotomized to relieve the structural contraction, after which the motor power rapidly increased. He was soon able to walk with support which a year subsequently he discarded, and now can move about with perfect ease."

By the work of Macewen Seguin, and Weir, here noticed, following

that of Horsley, v. Bergmann and others, certain portions of the brain and spinal cord may be said to have been brought completely with the domain of operative surgery. The subject of cerebral localization must however be still further extended before complete freedom of operation is attained, and meanwhile the surgeon looks to the physiologist for still more additions to our knowledge in this direction.

JAMES E. PILCHER.

BERGMANN ON THE SURGICAL TREATMENT OF DISEASES OF THE BRAIN.[1]

This paper is interesting not only from a surgical, but from a purely medical standpoint. It is an attempt to test a question which is fast becoming of vital moment, whether the general medical practitioner in calling upon the surgeon to operate in a given case must not be ready to exhibit as great an acquaintance with two tenets of modern surgery as his operating colleague. The time is past when the surgeon operates because the procedure is favored by a colleague who looks upon the knife as a mere mechanical agent devoid of all responsibility for danger or meddlesome interference because it is guarded by the paraphernalia of antisepsis. The careful exclusion of a certain class of cases from the domain of the surgery of the brain and a perfection of the methods applicable in fit cases is the true advance of surgery in this field. If in recent times the necessity of trephining in deep seated abscess has became urgent, it is because of two propositions: (1) The encapsulation of these processes and (2) the difficulty of their recognition. It is only in the acute abscess occurring on the surface of the brain, that we find no so-called limiting zone. These abscesses are traumatic in origin. The chronic brain abscess even if bounded by a so-called capsule is still liable to enlarge. The only result of non-interference in these abscesses is rupture into the ventricle and death. True, isolated cases are found where an abscess has discharged externally (Mac Leod), but these are so uncommon that they must be dis-

[1]Die Chirurgische Behandlung von Hirnkrankheiten von Prof. E. VON BERGMANN Arbeiter aus der Klinik, Berlin, 1887.